PREVALENCE OF RISK FACTORS FOR CORONARY ARTERY DISEASES AMONG MALE HIGH SCHOOL STUDENTS: A SCHOOL BASED CROSS-SECTIONAL STUDY.

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CERTIFICATE

This is to certify that **"Prevalence of risk factors for coronary artery diseases among male high school students: a school based cross-sectional study**. **"** is a bona fide work of Dr. Dinesh Kumar in partial fulfillment of the requirements for the M.D. Community Medicine examination (Branch XV) of The Tamilnadu Dr. M.G.R. Medical University to be held in March 2008.

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1. **Introduction and Justification**

Cardiovascular diseases are one of the most important causes of mortality and morbidity in developed as well as developing countries. India has one of largest numbers of patients with cardiovascular diseases including coronary artery disease. India is in the midst of a rapidly escalating 'epidemic' of Type II Diabetes and Coronary Heart Disease (CHD). Today, India has more diabetic patients than any other country, and it is predicted that CHD will soon become the leading cause of death. Projections based on the Global Burden of Disease study indicate the burden of atherothrombotic cardiovascular disease (CVD) in India will surpass that in any other region in the world by 2020 [1]. It is now well known that coronary artery disease (CAD) tends to occur earlier in life in Indians than in other ethnic groups.

Data from a multicentric study of men aged 35-59 years, conducted on behalf of the Indian Council of Medical Research during 1990-4, showed rising prevalence rates of coronary heart disease with increasing urbanisation (rural Vellore 3.15 per 1000 male population; rural Haryana 4.48/1000; urban Vellore 5.92/1000; and urban Delhi 8.72/1000 male population). In a rural population in Rajasthan, the prevalence of CAD was 3.5% [2]. The largest study, by far, was the one by Chadha et al.[3] from over 13500 urban dwellers in Delhi. Using clinical and ECG criteria, the prevalence rate of CAD was 9.7%, but major Q waves were seen in only 80 (1.4%) of the 5621 ECGs obtained Tertiary care centers have documented a steep rise in the proportion of admissions for coronary heart diseases [4]. In urban areas there was a significant increase in the prevalence of coronary heart disease in men between 20 and 39 years of age and women between 20and 49 years. In rural areas the increase in men was between 20 -39 years [2]. Rural

surveys have been inadequate and nationally representative surveys using standardized methods are unavailable.

It is clear that these disorders begin in childhood (or even earlier, in fetal life), and manifest due to interactions and accumulation of various risk factors throughout life. This is true for both developed as well as developing countries. The Addis Ababa University study, Ethiopia [5] with a citywide random sample of 1,436 (851 females and 585 males) young people (15-24 years of age) reported that 11.8% of males and 1.1% of females smoked. About 34% of the respondents consumed alcoholic beverages regularly, 7.0% of whom took more than 100 grams of alcohol per week. High fat intake and sedentary life-styles were registered in 4.5 and 8.4% of the respondents, respectively. About 6.0% of the females and 0.7% of the males were obese. The prevalence of elevated blood pressure (diastolic BP > 90 mmHg) was 7.1 %.

Smoking, hypertension, diabetes mellitus, hypercholesterolemia, obesity and reduced physical activity are considered conventional risk factors for CAD. Studies have shown the prevalence of these factors among Indians (with the exception of diabetes) to be no higher than that in other ethnic groups.

The role of leisure-time and work-related physical activity in determining risk of CAD in Indian patients has not been well studied. In an urban community in Rajasthan [6] more than 70% of the subjects were categorized as having a sedentary lifestyle. The adjusted odds ratio for a sedentary lifestyle as a risk factor for CAD was 1.7 in males and 4.5 in females.

The data on sustained hypertension in school going children is scanty in India. There is trend toward higher prevalence of hypertension in school going children which reflects

the changing scenario of cardiovascular diseases in current era due to the changing lifestyle, dietary pattern and decreased physical activity and increase in obesity. In urban population, 11.63% students were overweight and 2.35% were obese. In rural population prevalence of overweight and obesity was 4.70% and 3.63% respectively [7].

The effect of passive smoking on the risk of coronary heart disease is controversial. Many epidemiologic studies and reviews have pointed out the effect of passive smoking on the risk of coronary heart disease. Even so, the extent of the association between passive smoking and coronary heart disease is not fully known. Many children are regularly exposed to cigarette smoke at home or in other environments. Although the importance of psychosocial factors in the development and expression CAD has been debated, an extensive literature has now established that psychosocial factors contribute significantly to the pathogenesis of CAD.

Traditionally, a fat child is considered as an 'attractive' child, and is often referred to as a 'healthy' child. However, the adverse and serious consequences of childhood obesity are now proven beyond doubt. Obese children have substantial risks for morbidity such as hypertension and dyslipedemia even before they reach adulthood. Type 2 diabetes is beginning to emerge in children. Importantly, 50 to 80% of obese children become obese adults and all complications of adult obesity are worse if the obesity begins in childhood. There are not many studies looking at the development of CAD risk factors at an early age group. Available literature indicates the presence of the conventional CAD risk factors to an alarming rate among young Indians. This study aims to trace the development of these risk factors to early adolescence and pave way for planning an early intervention.

2. **Aim of the study**

Prevalence of risk factors for coronary artery diseases among male high school students: a school based cross-sectional study.

Aim:

1. To determine the prevalence of conventional risk factors for coronary artery disease among male school students in Kaniyambadi block and Vellore town
2. To estimate the difference in conventional risk factors for coronary artery disease between rural and urban residence of these students.

3. Study design and setting

This study is a cross-sectional study among 8^{th},9^{th} 10^{th} , 11^{th} and 12^{th} grade students from various secondary and high schools in Kaniyambadi block and Vellore town of Vellore district. . Kaniyambadi block is a community developmental block with a population of 10300 living in 82 villages. The Community Health Department of the Christian Medical College provides primary and secondary level health care through Community Health and Development Hospital (CHAD). Primary health care in the block is provided by a specially trained lady part time community health worker (PTCHW) selected from the community. The PTCHWs reside in the villages and serve either a single village or a cluster of small villages and serve a population of 1500. PTCHWs are supervised by Health Aides (HA), who are responsible for a population of about 5000 .The HAs are supervised by Public Health Nurses (PHN) and a physician, with one such a team for about 35,000 population. Doctors and nurses conduct regular clinics in the village through a mobile clinic, covering the entire block once a month while the PHN pays a fortnightly visit to each village in her area and provides additional service. The main activities carried out in each mobile clinic include antenatal care, treating minor ailments, chronic morbidity care, counseling and health education. Health education forms one of the most vital parts of the CHAD activities. Health education is conducted once in a fortnight by the health education team consisting of volunteers from the community and a health educator. Special health education programme are carried out for the students in the school dealing mainly with life style, reproductive health and developing coping up skills. Special stress management sessions are conducted around the exam and results time. Similar programmes are also conducted for the school

dropouts. The three Primary Health Centres (PHC) in the block also carry out routine school health checkups and health education programme.

Schools in Vellore town are provided health care through a special school health officer and three urban health medical officers. Health education activities are carried out by several non governmental organizations (NGO) as well.

4. Methodology:

4.1 Sample size calculation:

Sample size was calculated so as to power the study to pick the difference in the prevalence of overweight among rural (12%) and urban (5%) school going children. The sample size so calculated was 242 in each arm. The sample size was calculated using the formula for difference between two proportions

$$n = \frac{p*q*(z\alpha + z\beta)^2}{d^2}$$

Where n = sample size

p= pooled prevalence of overweight 8.5 %

q = 100-8.5 =91.5%

$z\alpha = 1.96$

$z\beta = 0.84$

d = difference between two prevalences (12-5) 7%.

4.2 Subject selection and recruitment:

A list of all schools providing 8th, 9th, 10th, 11th, 12th grade education in Kaniyambadi block was obtained. Three large schools at Kammavanpet, Penathur and Shozhavaram were selected because of their proximity and permission was obtained from the headmasters for conducting the study. Students from above said classes were requested to participate in study and those who consented were recruited.

From the urban area, the Don Bosco Boys High School was identified and permission obtained from the head master for conducting the study. Don Bosco Boys High School is

located in Officer's Line area of Vellore city. It is run by the Catholic Church and is exclusively for boys. Instruction is both in Tamil and English medium. Students to this school mainly come from surrounding areas of RN palayam, Kaspa, Velapadi, Thorapadi, Sainthapuram, Sankaranpalayam, and Vasathapuram as well as from surrounding villages. Addresses of the students were verified from the school records and only those students who were residing within the Vellore Municipality limits were invited to participate in the study.

4.3 Data collection:

The selected students were interviewed using a pre-tested questionnaire (Appendix no 1) administered by the investigator. Age was taken as number of completed years of life. Weight, height, waist circumference and blood pressure were measured as per the standardized protocols (Appendix no 2). Weighing machine and sphygmomanometer used were standardized before use. Only one set of weighing machine (KRUPS) and sphygmomanometer (Diamond deluxe mercurial type) were used for the entire study. Height measurements in centimeter were marked on a wall next to a flat floor by the investigator one for each school. Attempt was made to provide utmost privacy during the interview. It was explained to the students that the information collected during interview was confidential and that the name of the respondent was not recorded. All the interviews were conducted by the investigator in Tamil. Information regarding family history of hypertension, diabetes mellitus, ischaemic heart disease, stroke and dyslipidemias was confirmed with the local health worker (Health Aide) for rural students. As regarding the urban students an attempt was made to confirm the family history by further probing regarding symptoms, treatment details. Information for physical activity was collected for

a typical day. Similar information was collected separately for weekends (Saturday and Sunday) as physical activities on these days was found to be significantly different during piloting the questionnaire. Information regarding number and duration of academic and physical training periods was verified from the class teacher. Regarding distances traveled, name of places was obtained and approximate distance was calculated. At the end of the interview all participants were asked if they knew of any of their classmates smoking, consuming alcohol or using smokeless forms of tobacco. The children with identified risk factors were told about importance of the same and adequate intervention suggested wherever possible.

4.4 Data analysis:

The raw data was entered on a Microsoft Excel spread sheet. Data regarding physical activity was consolidated manually into various energy consumption categories before entering it onto spread sheet. Final analysis was done using SPSS for Windows 12.0 software.

5. Review of the literature

5.1 Definition:

Chronic non -communicable diseases (NCD) are assuming increasing importance among the adult population in both developed and developing country. There is no standard definition of chronic diseases. A EURO symposium in 1957 [8]defined chronic diseases as "an impairment of bodily structure and /or function that necessitates a modification of the patients' normal life, and has persisted over an extended period of time". The Commission on Chronic Illness in USA[9] has defined chronic diseases as "comprising all impairments or deviations from normal, which have one or more of the following characteristics:

a) are permanent
b) leave residual disability
c) are caused by non-reversible pathological alteration
d) require special training of the patient for rehabilitation
e) may be expected to require a long period of supervision ,observation or care".

In short there is no international consensus on a definition. Chronic diseases may be communicable or non-communicable and the later by far outnumber the former.

5.2 The spectrum of NCD:

The term NCD include a wide range of diseases involving the cardiovascular, renal, nervous and mental diseases, musculoskeletal conditions like arthritis, chronic non-specific respiratory diseases (asthma, chronic bronchitis, emphysema),permanent results of accidents, auto immune diseases ,senility ,blindness ,cancers ,diabetes, obesity

and various other metabolic and degenerative diseases. These are also referred to as "life style related diseases".

5.3 Epidemiologic transition:

The health status and disease profile of human society has historically been linked to the level of their economic development and social organization. The last century has witnessed the most dramatic improvement in health in the history of mankind. Life expectancy has increased from a global average of 46 years in 1950 to 66 years in 1998[10]. Similar trends are documented for India. With industrialization, in most advanced societies the major cause of death and disability has shifted from a predominance of nutritional deficiencies and infectious diseases to degenerative [chronic diseases such as cardiovascular disease (CVD) cancer , diabetes].This shift has been termed as "the epidemiologic transition". At any given time different countries in the world even different regions within a country are at different stages of epidemiologic transition .This transition can occur not only between different disease categories (e.g., deaths due to childhood diarrhea and malnutrition giving way to adult chronic diseases ,but also within a specific disease category (e.g., rheumatic disease of young giving way to chronic coronary artery diseases of middle age or valve calcification ,degeneration and heart failure of the elderly.

The burden of non-communicable diseases is increasing, accounting for nearly half of the global burden of disease (all ages), a 10 % increase from the estimated levels in1990. While the proportion of burden from the non-communicable diseases (NCD) in the developed countries remains stable, the proportion in the middle and low income countries is on rise. For most low and middle income countries, the increased incidence

of NCD adds to the continuing burden of Infectious, Nutritional and Perinatal diseases. This has been termed as the "double burden".

India has one of largest number of patients with cardiovascular diseases including the coronary artery disease. India is in the midst of a rapidly escalating 'epidemic' of Type II Diabetes and Coronary Heart Disease (CHD). Today, India has more diabetic patients than any other country in the world, and it is predicted that CHD will soon become the leading cause of death in our country. Projections based on the Global Burden of Disease study [1] estimate that by the year 2020, the burden of atherothrombotic cardiovascular disease (CVD) in India will surpass that in any other region in the world[11]. It is now well known that coronary artery disease (CAD) tends to occur earlier in life in Indians than in other ethnic groups.

5.4 The concept of risk factors:

In contrast to the communicable diseases the natural history of NCDs is very poorly understood. There are large gaps in our knowledge about the natural history of most NCDs. Some striking features are:

a) Absence of a known etiological agent

b) Multi factorial causation

c) Indefinite onset

d) Long latent period.

In absence of a known etiological agent and multi factorial causation, certain factors in a person's background or life style have been described that make the likelihood of the chronic diseases more probable. These have been collectively termed as `risk factors'. This concept of risk factors forms the basis of the integrated approach for control of the NCDs

5.5 The cardiovascular diseases (CVD), definition and spectrum:

The cardiovascular diseases comprise of a group of diseases that affect the heart and the blood vessels .These include:

a) Coronary heart disease – disease of the blood vessels supplying the heart muscle

b) Cerebrovascular disease - disease of the blood vessels supplying the brain

c) Peripheral arterial disease – disease of blood vessels supplying the arms and legs

d) Rheumatic heart disease – damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria

e) Congenital heart disease - malformations of heart structure existing at birth.

f) Deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs. [12]

Of these hypertension and IHD are the most important contributors to mortality and morbidity. The major risk factors of CVD are tobacco use, inappropriate diet and physical inactivity.

5.6 CVD and epidemiologic transition:

The epidemiologic transition occurs not only between different disease categories (e.g., deaths from childhood diarrhea and malnutrition giving way to adult chronic diseases), but also within a specific disease category (e.g., rheumatic heart disease of the young giving way to chronic coronary artery diseases of middle age or valve calcification, degeneration, and heart failure of the elderly) [1].

For countries in the earliest stage of development, the predominant circulatory diseases are rheumatic heart disease, those due to other infections, and nutritional deficiency–related disorders of the heart muscle. Geographic regions experiencing this phase include Sub-Saharan Africa (SSA) and the rural areas of South America and South Asia (SA). During the second stage, as infectious disease burdens are reduced and nutrition improves, diseases related to hypertension, such as hemorrhagic stroke and hypertensive heart disease, become more common. Regions experiencing this phase include China and other Asian countries. During the third stage, as life expectancy continues to improve, high-fat diets, cigarette smoking, and sedentary lifestyles become more common. Non-communicable diseases then predominate, with the highest mortality caused by atherosclerotic CVD, most frequently ischemic heart disease and atherothrombotic stroke, especially at ages below 50 years. This phase is found in urban India, Latin America, and the former socialist countries. For most developing and middle-income countries, the increased incidence of CVD adds to the continuing burden of infectious, nutritional, and perinatal diseases, which has been termed the "double-burden". During the fourth stage, increased efforts to prevent, diagnose, and treat ischemic heart disease and stroke are able to delay these diseases to more advanced ages. The regions that have reached this fourth stage include Western Europe, North America (excluding some parts of Mexico), Australia, and New Zealand.

Previously the fourth stage was considered to be the "final" stage of the epidemiologic transition. However, Yusuf et al. have proposed that a fifth stage, where social upheaval or war breaks down existing social and health structures, leading to a resurgence of conditions seen in the first two stages. Diseases of the third and fourth stages persist. This

regressive stage is associated with increased deaths due to both cardiovascular (CV) and non-CV causes such as infectious diseases, violence, and consequently a decrease in life expectancy. It is likely that Russia represents such a situation, where in the last 10 years; life expectancy has shortened with a marked increase in deaths from CV diseases, infectious diseases, accidents, and violence.

5.7 Coronary artery disease (ischaemic heart disease):

The IHD (syn: coronary artery disease, coronary heart disease) has been defined as "impairment of the heart function due to inadequate blood flow to the heart compared to its needs, caused by obstructive changes in the coronary circulation to the heart"[13]. The IHD may manifest in many presentations:

a) Asymptomatic coronary atherosclerosis

b) Angina pectoris of effort

c) Myocardial infarction

d) Cardiac arrhythmias

e) Cardiac failure

f) Chronic ischaemic heart disease

g) Sudden death

IHD is one of the most important causes of mortality as well as morbidity worldwide. The disease burden varies widely in different part of the world. The highest coronary mortality is presently seen in North Europe. In many developed countries though there is a decline the CHD are still the most frequent cause of death.

5.8 CHD and India:

India over last one decade has emerged as one of the fastest growing economies. This boom has brought with it newer trends in life style and disease pattern. The Global Burden of Disease (GBD) study estimates that 52% of CVD deaths occur below 70 years in India as compared to 23% in established market economies (EME), resulting in a profound adverse impact on its economy. Currently Indians experience CVD deaths at least a decade earlier than their counterparts in countries with EME.

Data from a multicentric study of men aged 35-59 years, conducted on behalf of the Indian Council of Medical Research during 1990-4, showed rising prevalence rates of coronary heart disease with increasing urbanisation (rural Vellore 3.15 per 1000 male population; rural Haryana 4.48/1000; urban Vellore 5.92/1000; and urban Delhi 8.72/1000 male population). In a rural population in Rajasthan, Gupta et al. found a 3.5% prevalence of CAD [6]. The largest study, by far, was the one by Chadha et al.[3] who collected data from over 13500 urban dwellers in Delhi. Using clinical and ECG criteria, the prevalence rate of CAD was 9.7%, but major Q waves were seen in only 80 (1.4%) of the 5621 ECGs obtained Tertiary care centers have documented a steep rise in the proportion of admissions for coronary heart diseases [4]. In urban areas there was a significant increase in the prevalence of coronary heart disease in men in the age groups 20-29 and 30-39 years and in women in the age groups 20-29, 30-39 and 40-49 years. In rural areas the increase in men in the age groups 20-29 and 30-39 years [2]. Rural surveys have been inadequate and nationally representative surveys, using standardized methods, are unavailable. It is now emerging convincingly that these disorders begin in childhood (or even earlier, in fetal life), and manifest due to interactions and accumulation of

various risk factors, throughout the life course. This is true for both developed as well as developing countries.

5.9 Risk factors for coronary heart disease:

Ecological, case-control, and cohort studies in many populations have identified a number of markers associated with either an increased or a decreased risk of CVD. Whether these associations are causal is decided by applying several criteria, such as strength and consistency of association, temporal relationship, dose-response relationship, biologic plausibility, experimental evidence, and very importantly, concordant evidence from randomized human trials when available. It is the coherence of information from several different types of studies which has led to our body of knowledge and provides persuasive evidence of the causal link of several risk factors with CVD. It has been suggested that conventional risk factors only explain about half of the variance in coronary heart disease. The principal risk factors for CAD can be variously classified, one commonly used classification is that based on possibility of intervention namely modifiable and not modifiable.

Not-modifiable risk factors:

a) Age

b) Sex

c) Family history

d) Genetic and racial factors

e) Personality

Modifiable risk factors:

a) Smoking in all its form

b) High blood pressure

c) Elevated serum cholesterol

d) Diabetes mellitus

e) Obesity

f) Sedentary habits

g) Stress.

Risk factors have also been classified based on degree of evidence available regarding causality [1].

Risk factors that are causally linked:

1. Tobacco consumption
2. Elevated LDL
3. Low HDL
4. High blood pressure
5. Elevated glucose
6. Physical inactivity
7. Obesity
8. Diet

Risk markers that show associations:

1. Low socioeconomic status
2. Elevated prothrombotic factors: fibrinogen, PAI-1
3. Markers of infection or inflammation
4. Elevated homocysteine
5. Elevated lipoprotein(a)

6. Psychological factors (depression, anger proneness, hostility, stress, acute life-events) and breakdown in social structures (loss of social support and cohesion).

5.9.1 Psychosocial factors:

Although the importance of psychosocial factors in the development and expression CAD has been debated, an extensive review has now established that psychosocial factors contribute significantly to the pathogenesis of CAD. This evidence is composed largely of data relating CAD risk to 5 specific psychosocial domains: (1) depression, (2) anxiety, (3) personality factors and character traits, (4) social isolation, and (5) chronic life stress. Pathophysiological mechanisms underlying the relationship between these entities and CAD can be divided into behavioral mechanisms, whereby psychosocial conditions contribute to a higher frequency of adverse health behaviors, such as poor diet and smoking, and direct pathophysiological mechanisms, such as neuro-endocrine and platelet activation. Brief episodes of mental stress, similar to those encountered in everyday life, may cause transient (up to 4 hours) endothelial dysfunction in healthy young individuals. This might represent a mechanistic link between mental stress and atherogenesis[14].

An extensive body of evidence from animal models (especially the cynomolgus monkey, *Macaca fascicularis*) reveals that chronic psychosocial stress can lead, probably via a mechanism involving excessive sympathetic nervous system activation, to exacerbation of coronary artery atherosclerosis as well as to transient endothelial dysfunction and even necrosis. Evidence from monkeys also indicates that psychosocial stress reliably induces ovarian dysfunction, hypercortisolemia, and excessive adrenergic activation in premenopausal females, leading to accelerated atherosclerosis[15]. Although psychosocial stresses have been reviewed here as individual entities, generally, these stresses tend to

cluster together. When they do so, risk ratios for cardiac events often rise substantially. For example, in one study of post-MI patients, the presence of high levels of life stress and social isolation were each associated with an ≈2-fold increase in subsequent events.[16] But when the 2 factors occurred together, the rate of subsequent events was 4-fold higher. A similar synergy between these 2 factors has also been reported among healthy individuals[17].Similarly, the combination of anxiety and depression compounds cardiac risk in post-MI patients[18].and many other examples can be found within the psychosocial literature. These data indicate that psychological factors occurring in combination substantially magnify risk associated with individual psychological factors, resulting in risk elevations that are comparable to those associated with hypertension, hypercholesterolemia, and other major risk factors for CAD. Furthermore, psychosocial factors also interact synergistically with conventional CAD risk factors to heighten the risk for cardiac events. For example, depressed patients who smoke have a substantially higher risk of cardiac events than depressed patients who do not smoke[19]. Work-related stress is the most widely studied chronic life stress relative to CAD. Although many aspects of one's work environment relative to the development of CAD have been studied, much interest has focused on models of inherent "tension" at work. One such model has been the "job strain" model, defined by Karasek et al [20] as jobs with high demand but low decision latitude. In one prospective study of 1928 male workers followed up for 6 years, job strain was associated with a 4-fold increase in the risk of cardiovascular system–related death. Subsequent studies have supported the relationship between job strain and CAD risk, but negative studies have also been reported. Anecdotal reports and case studies have long reported a relationship between acute stress and the

development of cardiac disease. In addition, the effects of acute stress on heart disease are well supported by epidemiological studies regarding natural life stressors. An acute stressor associated with increased rates of cardiac events is bereavement. For example, in one study of 95 647 individuals followed up for 4 to 5 years, the highest relative mortality occurred immediately after bereavement, with a >2-fold higher risk for men and 3-fold higher risk for women [21].

5.9.2 Family history of cardiovascular disease:

Offspring with a positive history for parental cardiovascular disease already show adverse risk factor levels starting in childhood. Certain factors become more obvious at a later developmental stage. The Bogalusa study [22]demonstrated the adverse effect in risk factor variables associated with parental history of disease, especially after the pubertal development stage. There is an association between blood pressure levels in children and family history. The importance of this relation is highlighted by the positive association between blood pressure levels in children and changes in left ventricle size and function as detected by echocardiography and a relation between cardiac anatomy and function with familial history of hypertension. The children with positive family history of diabetes have relatively more insulin resistance. In a study done in New Delhi [23]involving children of young parents with CAD, serum total and LDL-Cholesterol, blood sugar and blood pressure, both systolic and diastolic were significantly higher in test group as compared to controls though there was no significant difference observed for weight and body mass index (BMI) between the two groups. The insulin levels were also significantly high in the test cases. Interestingly, certain risk factor levels in children were

found to change adversely and selectively with parental diseases. Example the Bogalusa study [22] showed adverse levels of blood pressure and lipid/lipoprotein associated with parental myocardial infarction and adverse levels of lipid/lipoprotein, obesity, and insulin associated with parental diabetes mellitus. The study also showed that these adverse effects become more apparent at older ages when risk increases for offspring along with a greater number of occurrences of parental disease.

5.9.3 Obesity:

Obesity is defined as a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired [24]. Obesity is a risk factor for adult coronary heart disease and is increasing in prevalence among youths as well as adults. The Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study [25] collected arteries, blood, and other tissue from approximately 3000 persons aged 15 to 34 years dying of external causes and autopsied in forensic laboratories. They concluded that obesity is associated with accelerated coronary atherosclerosis in adolescent and young adult men. Body mass index (BMI) was not associated with coronary atherosclerosis in young women. A retrospective study based on 210 medico-legal autopsies of 5-15 y old children who had suffered violent death in the Province of Oulu, Finland, was carried out in 1970-1995 [26]. The results of the study point to an important role of excess body weight and adiposity in the development of early myocardial and coronary changes in childhood. Coronary fatty streaks were not found at all in the leanest individuals in this relatively large group and the cardiac size adjusted for body size indicated hypertrophy with increasing adiposity. Same investigator in another study investigated in a group of 32

forensic autopsy cases that consisted of sudden deaths from violent causes of previously healthy men less than 40 years of age (median age 31 years) [27]. Intimal macrophage foam cells and smooth muscle cells were detected by immunohistochemistryIntimal macrophage foam cells and smooth muscle cells were detected by immunohistochemistry. Significant positive correlations were found between waist –hip ratio (WHR) and the overall degree of coronary narrowing and the intima-media thicknesses of the left anterior descending artery and right coronary artery when adjusted for age. Intima-media thickness was also related to tertiles of WHR. Heart weight indexed to height$^{2.7}$ showed a significant positive correlation with BMI, waist circumference, WHR, and the size of intra-abdominal fat deposits, of which WHR was the best predictor of mild cardiac hypertrophy. There are not many studies which have studied role of obesity in CHD in women. The study on Chinese women [28] indicated that WHR was positively associated with the risk of CHD in both younger and older women, while other anthropometric measurements, including BMI, were related to CHD risk primarily among younger women.

The International Classification of adult underweight, overweight and obesity according to BMI [29].

Classification	BMI(kg/m²)	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34-99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

The studies have shown that many Asian populations have higher proportion of body fat compared to Caucasians of the same age, gender and BMI. These studies also showed that Asians have increased risk for cardiovascular diseases and diabetes mellitus at relatively low BMI levels. World Health Organization (WHO) convened an expert consultation to review the BMI cut offs to define risks in Asian populations and recommended that for some Asians, BMI of 23 kg/m2 or higher marks a moderate increase in risk while a BMI of 27.5 kg/m2 or more represents high risk. However the current WHO BMI cut-offs have been retained for international comparison. The recommended BMI additional trigger points for public health action for Asian populations are:

BMI (kg/m2) for Adults	**Health Risk**
27.5 and above	High Risk
23 – 27.4	Moderate Risk
18.5 – 22.9	Low Risk (healthy range)
Below 18.5	Risk of nutritional deficiency diseases and osteoporosis[30].

A limitation of BMI is that it cannot differentiate an obese individual from a muscular one. It also cannot locate the site of fat *e.g*., people with 'central obesity' may have normal BMIs. In spite of several limitations, BMI as of now appears to be the most practical way of measuring and comparing obesity for clinical and epidemiological purposes.

BMI values for adults are age independent and same for both sexes. However in children, BMI changes physiologically (substantially) with age and sex. At birth the median BMI is as low as 13 kg/m2, increasing to 17 kg/m2 at age 1, decreasing to 15.5 kg/m2 at age 6, then increasing to 21 kg/m2 at age 20. Many countries have published BMI-for-age charts for their populations, and some have also defined cut-off points on these charts to define overweight and obesity. In an Indian Council for Medical Research (ICMR) study anthropometric data on 21,070 children aged 1 to 17 years collected by the National Nutrition Monitoring Bureau (NNMB) in 9 States during 2000-01 surveys was utilized. The software obtained from Dr.T.J. Cole was used and the normalized mean (M), the Coefficient of variation (S) and the Box-Cox power (L) curves were obtained as smoothed functions of age/sex by using the above data base. These age/sex specific BMI centiles have been converted into SD scores [31]. In a study done in Ludhiana in the urban

population, 11.63% students were overweight and 2.35% were obese. In rural population prevalence of overweight and obesity was 4.70% and 3.63% respectively [7].

5.9.4 Smoking:

Active cigarette smoking is one of the most important modifiable risk factors for coronary heart disease. The smokers tend to have hypertension, dyslipidaemia and increased production of free oxygen radicals, perhaps by attenuation of oxidative stress by cigarette smoking. This makes them prone for premature coronary artery disease. There is no clear cut data on the extent of smoking in Indian youth. The prevalence of ever-use of tobacco for North India varied between 2.9 to 8.5% in boys and 1.5 to 9.8% in girls [32]. The prevalence was highest in Chandigarh and lowest in Punjab. Between 16 to 46% of students were exposed to the habit of tobacco among parents or friends. There were 10 to 34% students who were passively exposed to environmental tobacco smoke. In similar survey for south India about 10% of students aged 13-15 in Tamil Nadu had ever used tobacco [33]. For the north –eastern states ever tobacco users ranged from 75.3% (Mizoram) to 40.1% (Assam). Over 65% of users reported initiation at 10 years of age or earlier in all states except Mizoram (23.1%). The range of current tobacco use (any product) was 63% (Nagaland) to 36.1% (Assam). Current smokeless tobacco use ranged from 49.9% (Nagaland) to 25.3% (Assam). Mizoram reported the highest current smoking (34.5%, mainly cigarette) and Assam reported the lowest (19.7%, again mainly cigarette). Current smoking among girls (8.3% to 28.2%) was also quite high. Over half of current cigarette smokers (53.2% to 96.3%) and a high proportion of current smokeless tobacco users (38.5% to 80.8%) reported feeling like having tobacco first thing in the

morning [34].The effect of passive smoking on the risk of coronary heart disease is controversial. Many epidemiologic studies and reviews have pointed to the effect of passive smoking on the risk of coronary heart disease. Even so, the extent of the association between passive smoking and coronary heart disease is not fully known. Many children are regularly exposed to cigarette smoke at home or in other environments.

In one meta analysis nonsmokers exposed to environmental smoke had a relative risk of coronary heart disease of 1.25 (95 percent confidence interval, 1.17 to 1.32) as compared with nonsmokers not exposed to smoke. Passive smoking was consistently associated with an increased relative risk of coronary heart disease in cohort studies (relative risk, 1.21; 95 percent confidence interval, 1.14 to 1.30), in case–control studies (relative risk, 1.51; 95 percent confidence interval, 1.26 to 1.81), in men (relative risk, 1.22; 95 percent confidence interval, 1.10 to 1.35), in women (relative risk, 1.24; 95 percent confidence interval, 1.15 to 1.34), and in those exposed to smoking at home (relative risk, 1.17; 95 percent confidence interval, 1.11 to 1.24) or in the workplace (relative risk, 1.11; 95 percent confidence interval, 1.00 to 1.23). A significant dose–response relation was identified, with respective relative risks of 1.23 and 1.31 for nonsmokers who were exposed to the smoke of 1 to 19 cigarettes per day and those who were exposed to the smoke of 20 or more cigarettes per day, as compared with nonsmokers not exposed to smoke (P=0.006 for linear trend) [35].

5.9.5 Hypertension:

Prospective studies have identified increased blood pressure level as a major risk factor for coronary artery disease (CAD) [36] .In a study undertaken to investigate relationships of blood pressure level and diagnostic category with coronary artery calcification (CAC) in a community-based sample of 803 white individuals 40 years or older who were asymptomatic and not physician- or self-referred, not high risk, nor selected based on risk factor status. Each measure related to blood pressure (i.e. systolic blood pressure, diastolic blood pressure, mean arterial pressure, hypertension status, and use of antihypertensive medications) was positively and statistically significantly associated with presence and quantity of CAC in each sex with the exception of systolic blood pressure in men and use of antihypertensive medications in women. The relationships between blood pressure measures and CAC were not altered by effects of body size, body shape, measures of lipid metabolism, having a history of smoking, use of lipid lowering medications, or use of antihypertensive medications [37].The tracking phenomenon for hypertension has been well documented [38,39].

Definition of hypertension:

Hypertension is defined as average systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) that is more than 95th percentile for gender, age, and height on 3 or more occasions. . Prehypertension in children is defined as average SBP or DBP levels that are greater 90th percentile but less 95th percentile. As with adults, adolescents with BP levels greater than 120/80 mm Hg should be considered prehypertensive. A patient with BP levels greater than 95th percentile in a physician's office or clinic, who is normotensive outside a clinical setting, has "white-coat hypertension. "Ambulatory BP monitoring

(ABPM) is usually required to make this diagnosis[40]. The revised BP Tables including the 50th, 90th, 95th, and 99th percentiles by gender, age, and height have been provided. Similar Tables for Indian children are also available and have been used in present study[41].

5.9.6 Dyslipidemias :

Adverse levels of serum lipids tend to persist over time into adolescence and young adulthood, underlying the progression of CAD. Many studies have documented the conventional dyslipidemia in patients of CAD and their children. The children of premature coronary artery disease patients have significant incidence of dyslipidemia characterized by high Lipo- protein(a) and Apo B-100 levels,low density cholesterol (LDL),total cholesterol (TC),total triglycerides (TG) and low Apo A-I ,high density cholesterol (HDL) levels compared to age matched controls[42]. In a Brazilian study, of the 414 children and adolescents analyzed in the study, about 30% presented an atherogenic lipid profile, characterized by higher levels of Triglyceride, Total and LDL- Cholesterol [43]. A school-based, cross-sectional survey in Chennai [44] among school children aged 12–19 years (n = 2,640; 1,323 boys and 1,317 girls) found that 64.8% of normal weight children and adolescents had at least one cardiometabolic risk factor. The commonest cardiometabolic abnormality was low HDL cholesterol, followed by elevated triglycerides. Insulin resistance seems to be associated with elevated levels of fasting plasma glucose, blood pressure, and triglycerides and with their clustering. Low plasma HDLC, high plasma triglyceride and high BMI in childhood are associated with low insulin-sensitivity index values in young adulthood [45].

5.9.7 Elevated blood glucose levels and increased insulin resistance:

Low insulin sensitivity underlies the metabolic syndrome that includes central obesity, dyslipidemia, hyperglycemia, hypertension, impaired fibrinolysis, and atherosclerosis. Insulinemia in general is inversely related to insulin sensitivity, but the relationship is not linear and it is usually absent in diabetic individuals who account for a significant proportion of people with low insulin sensitivity. It has been argued that insulin resistance is involved in the pathogenesis of essential hypertension. Compensatory hyperinsulinemia seen in insulin resistance is suggested to play a causal role in development of hypertension because hyperinsulinemia has been associated with proliferation of vascular smooth muscle cells, increased renin output, increased renal sodium retention, and increased catecholamine secretion, elevated activity of PAI-1. The relationship between serum insulin levels and CHD remains controversial. The Insulin Resistance Atherosclerosis Study (IRAS) [46] demonstrated that the association between insulin sensitivity and CAD was highly significant and independent of the effects of lipids, hypertension, and cigarette smoking. Low insulin sensitivity is associated with both subclinical carotid atherosclerosis and clinical CAD. However The Bruneck Study [47] suggests that both hyperinsulinemia and "hypoinsulinemia" are independent indicators of CHD. Furthermore, it is proposed that the relationship between CHD and fasting insulin is U-shaped, whereas that between CHD and postglucose insulin may be J-shaped. The results were consistent for men and women, as well as in younger and older subjects. Low birth weight is associated with adult insulin resistance and diabetes. Children born with low birth weight have significantly greater fasting glucose, fasting insulin levels and insulin resistance at mid and late childhood [48]. Impaired glucose tolerance and type 2 diabetes are far more common in obese children. . Of a total of 1083 adolescents attending school

(aged 12-17 years) who participated in a community-based cross-sectional survey in Chandigarh a substantial number (4.2%) of adolescents and 36.6% of overweight adolescents had metabolic syndrome [49].

5.9.8 Physical activity and CAD:

Physical activity is now recognised as an important health enhancing behaviour. Physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control. Individuals who are more physically active appear to have lower rates of all-cause mortality, probably due to a decrease in chronic diseases including coronary artery disease (CAD). This may result from an improvement in cardiovascular risk factors in addition to enhanced fibrinolysis, improved endothelial function, decreased sympathetic tone, and other yet undetermined factors. The association between CVD risk factors and physical activity/fitness is weak, when risk factors are analysed isolated. In the normal healthy population of children, studies have shown that risk factors cluster and this clustering is strongly related to low physical activity or fitness. In European children [50] it has been found that as many as 15% of 9-y-old children has clustered risk. Most of the overweight and obese children are among these, but many of the children are lean inactive children, who may later become overweight because of insulin resistance. The role of leisure-time and work-related physical activity in determining risk of CAD in native Indian patients has not been well studied. In a study of an urban community in Rajasthan [51] more than 70% of the subjects were categorized as having a sedentary lifestyle. The adjusted odds ratio for a sedentary lifestyle as a risk factor for CAD was 1.7 in males and 4.5 in females. In the Chennai

study prevalence of most of the components of metabolic syndrome (diabetes P < 0.001, obesity P = 0.003, abdominal obesity P < 0.001 and hypertension P < 0.001) and metabolic syndrome per se (P < 0.001) increased significantly with decrease in physical activity. Subjects in the light-grade activity group also had higher odds of CAD (OR 2.42, 95% confidence interval 1.40, 4.24, P = 0.011), compared with the heavy-grade activity group [52]. For physical activity**,** it is recommended that individuals engage in adequate levels throughout their lives. Different types and amounts of physical activity are required for different health outcomes: at least 30 minutes of regular, moderate-intensity physical activity on most days reduces the risk of cardiovascular disease and diabetes, colon cancer and breast cancer [53]. The 1995 report from the Centers for Disease Control and Prevention and the American College of Sports Medicine (CDC/ACSM) recommended that "every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week". The International Association for the Study of Obesity report recommends that, given current environmental factors, 30 min of moderate daily exercise may be insufficient for many persons to maintain weight. For those who find that 30 min of activity/d does not prevent weight gain, additional exercise is recommended [54]. To promote and maintain health, all healthy adults aged 18 to 65 yr need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days each week. [I (A)] Combinations of moderate- and vigorous-intensity activity can be performed to meet this recommendation [55].

5.10 Parental drug use characteristics and smoking:

Childhood living conditions are strong determinants of daily smoking. Much of their influence seems to be mediated through current living conditions, which are also determined by childhood conditions. Determinants of smoking behaviour are developed throughout the life course. The importance of the respondent's education and parental smoking can not be overemphasized [56]. Increasing evidence suggests that the children of drug abusers may be at elevated risk for maladjustment and problem behaviors, including substance use [57].The adolescent children of drug-abusing parents may be especially susceptible to tobacco use, which in turn has been linked, both concurrently and prospectively, with drug use and psychopathology .Results of the more extensive literature on parental tobacco use and children's smoking have been somewhat inconsistent, but most studies have shown an increased risk for offspring smoking in both adolescence and adulthood.[58,59] In general, research suggests that parental tobacco and drug use may have a considerable impact on the initiation and persistence of smoking in the adolescent child. Li et al, [60] for example, found that parents' tobacco use was significantly associated with the later use of cigarettes, marijuana, and alcohol by their adolescent children, with the strongest influence found for smoking. The researchers also showed that any parental substance use was significantly related to higher levels of adolescent smoking.

5.11 Urbanization and changing villages:

One of the most marked societal and environmental changes has been associated with urbanization. The rates of urbanization are increasing globally, from 36.6% of the world population living in urban areas in 1970, to 44.8% in 1994. This proportion is projected to

increase to 61.1% by 2025 .With urbanization (or migration to Western environments), there is a marked increase in consumption of energy rich foods, a decrease in energy expenditure (through less physical activity,) and a loss of the traditional social support mechanisms. Migration of rural to urban environment leads to unusual stress due to maladjustment and subsequent inadequate coping due to lack of social support. In addition to increased migration of individuals from rural to urban areas, rural areas are themselves also being transformed. For example, increased mechanization in agriculture and increased use of automobile and bus transportation in rural areas are leading to a decrease in physical activity. Concomitantly, global influences (via television or increased availability of processed food) on lifestyles perceived to be desirable or modern are changing the types of food consumed in both urban and rural areas. Coronary artery disease and coronary risk factors were two or three times higher among the urban compared with the rural subjects, which may be due to greater sedentary behaviour and alcohol intake among urbans [61].

5.12 Childhood and coronary artery disease:

It is now clear that these disorders begin in childhood (or even earlier, in fetal life), due to interactions and accumulation of various risk factors, throughout life. This is true for both developed and developing countries. The Atherosclerosis Risk in Young Adults (ARYA) study [39] investigated the association between birth size and the absolute risk for coronary heart disease in healthy young adults. The results suggest that small birth size is associated with an increased risk score for coronary artery disease in young adulthood. The Addis Ababa University study, Ethiopia [5] done on a citywide random sample of 1,436 (851 females and 585 males) young people (15-24 years of age) reported that 11.8% of males and 1.1% of females smoked, about 34% of the respondents consumed

alcoholic beverages regularly, 7.0% of whom took more than 100 grams of alcohol per week. High fat intake and sedentary life-styles were registered in 4.5 and 8.4% of the respondents, respectively. About 6.0% of the females and 0.7% of the males were obese. The prevalence of elevated blood pressure (diastolic BP > 90 mmHg) was 7.1 %. The data on sustained hypertension in school going children is scanty in India. Increased blood pressure (BP) in young adulthood is associated with cardiovascular morbidity and mortality. Longitudinal studies of patients at young ages are, however, limited. The Atherosclerosis Risk in Young Adults (ARYA) study [62] tracked the blood pressure of 750 adolescents from 13 years to 30 years and also assessed the sub clinical atherosclerosis by sonographic measurements of carotid intima-media thickness (CMIT). The findings suggest that elevated blood pressure at adolescence and a relative increase in blood pressure from adolescence to adulthood unfavorably affect cardiovascular risk, as indicated by increased CIMT. There is trend toward higher prevalence of hypertension in school going children which reflects the changing scenario of cardiovascular diseases in current era due to the changing lifestyle, dietary pattern and decreased physical activity and increase in obesity. In urban population, 11.63% students were overweight and 2.35% were obese. In rural population prevalence of overweight and obesity was 4.70% and 3.63% respectively [7].

In the Bogalusa autopsy study, the extent of involvement of the aortic and coronary-artery wall with fatty streaks and fibrous plaques increased significantly with age among children and young adults who died prematurely of non-cardiac causes. Traditional coronary risk factors, including body-mass index, systolic blood pressure, low-density lipoprotein cholesterol levels, triglyceride levels, and cigarette smoking and, to a lesser

extent, high-density lipoprotein cholesterol levels and diastolic blood pressure, tended to be associated with the extent of lesions in both the aorta and the coronary arteries. Furthermore, risk factors tended to cluster in individual subjects, and a higher number of risk factors predicted more extensive lesions [63]. New evidence from the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group [25] revealed dramatic and early differences in atherosclerosis between those with good and bad risk factor profiles. The differences appeared by age 15. This evidence indicated that atherosclerosis begins in early adulthood, and plaques, an advanced form of fatty streak, can be found in the arteries and coronary vessels of children and adolescents. Coronary heart disease risk factors can be quantified as "CHD risk point standards," which can provide a quantitative interpretation. Coronary heart disease risk increases with age and with a positive family history of premature CHD; furthermore, premature CHD is a very important risk factor [64].In the Muscatine cohort, [65] who were examined over the age range of 8 to 42 years, childhood risk factors, including total cholesterol for both sexes and BMI only for women, predicted CMIT. Both childhood obesity and cholesterol levels have been shown to track into young adulthood.

Traditionally, a fat child is considered as an 'attractive' child, and is often referred to as a 'healthy' child. However, the adverse and serious consequences of childhood obesity are now proven beyond doubt .However, obese children have substantial risks for morbidity such as hypertension and dyslipedemia even before they reach adulthood. Type 2 diabetes is beginning to emerge in children. Importantly, 50 to 80% of obese children become obese adults and all complications of adult obesity are made worse if the obesity begins in childhood. There are not many studies that have looked the development of

CAD risk factors at an early age group. Available literature indicates the presence of the conventional CAD risk factors to an alarming rate among young Indians.

6. Results

Table 6.1 Age-wise distribution of study population:

Age in years	Rural	Urban
	Frequency	Frequency
12	13 (5.2 %)	25 (10.0 %)
13	54 (21.6 %)	71 (28.4 %)
14	74 (29.6 %)	83 (33.2 %)
15	55 (22.0 %)	48 (19.2 %)
16	30 (12.0 %)	22 (8.8 %)
17	16 (6.4 %)	1 (0.4 %)
18	7 (2.8 %)	0 (0 %)
19	1 (0.4 %)	0 (0 %)
Total	250 (100 %)	250 (100 %)

The Table 6.1 shows the age-wise distribution of the study population .The urban population is comparatively younger (mean 13.9 vs. 14.6, p=0.000). The extra older students in the rural arm are mainly due to those studying in the class 11 and 12 as well as due to more number of failures among the rural students.

Table 6.2 Class-wise distribution of the study population:

Class	Rural	Urban
	Frequency	Frequency
8	91 (36.4 %)	105 (42.0 %)
9	82 (32.8 %)	90 (36.0 %)
10	55 (22.0 %)	55 (22.0 %)
11	8 (3.2 %)	0 (0 %)
12	14 (5.6 %)	0 (0 %)
Total	250 (100 %)	250 (100%)

The Table 6.2 shows that there were no students from the 11^{th} and 12^{th} classes in the urban population.

Table 6.3 Religion-wise distribution of the study population:

Religion	Rural	Urban
	Frequency	Frequency
Hindu	220 (88.0 %)	156 (62.4 %)
Muslim	19 (7.6 %)	72 (28.8 %)
Christian	11 (4.4 %)	22 (8.8 %)
Total	250 (100 %)	250 (100 %)

Table 6.3 shows that the proportion of students belonging to Muslim (28.8%) and Christian (808%) were significantly higher in the urban arm probably due to the location of this school in a Muslim dominated area and the nature of the school management.

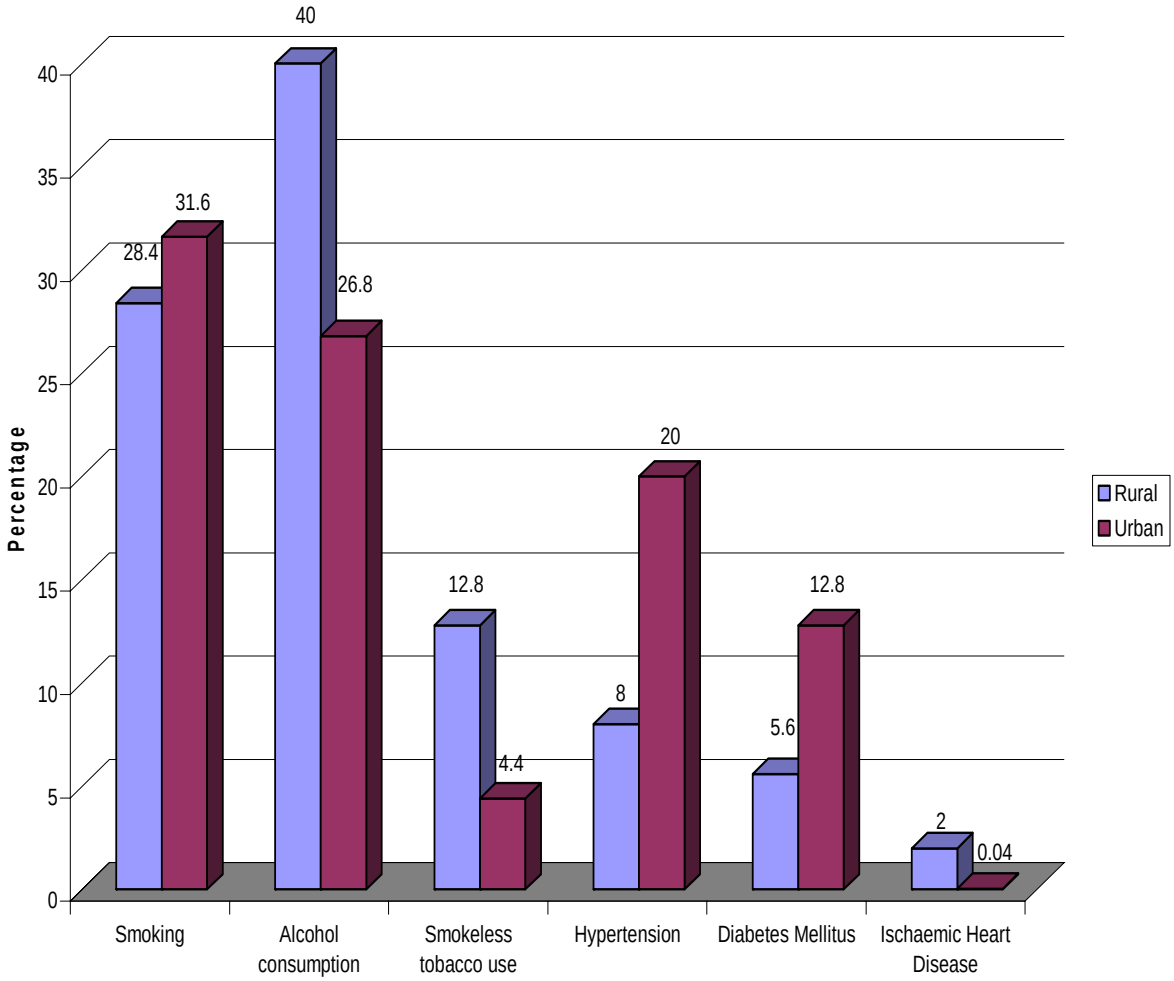
Table 6.4 Distribution of various measurements in rural area

Risk factor	Total	Minimum	Maximum	Mean	Standard deviation
Waist circumference (cm)	250	49	115	61.25	7.26
Systolic BP (mmHg)	250	63	129	98.6	12.64
Diastolic BP(mmHg)	250	34	91	61.27	10.8
BMI (kg/m^2)	250	12.57	42.24	16.58	2.99

Table 6.5 Distribution of various measurements in urban area

Risk factor	Total	Minimum	Maximum	Mean	Standard deviation
Waist circumference (cm)	250	50	105	63.35	8.507
Systolic BP (mmHg)	250	76	140	100.64	12.54
Diastolic BP(mmHg)	250	38	95	60.99	9.18
BMI (kg/m^2)	250	11.81	30.46	16.78	3.00

Figure 1.Parental risk factors by residence



The mean values of systolic blood pressure and body-mass index were greater for the rural students whereas waist circumference and diastolic blood pressure was more among the urban students as depicted in the Table 6.4 and 6.5. Of the above measurements only waist circumference was statistically different between the two groups (p=0.003).

Table 6.6 Parental risk factors by residence:

Risk factor	Rural	Urban
	Presence of risk factor	Presence of risk factor
Smoking	71 (28.4 %)	79 (31.6 %)
Alcohol consumption	100 (40 %)	67 (26.8 %)
Smokeless tobacco use	32 (12.8 %)	11 (4.4 %)
Hypertension	20 (8.0 %)	50 (20 %)
Diabetes Mellitus	14 (5.6 %)	32 (12.8 %)
Ischaemic heart disease	3 (1.2 %)	1 (0.04 %)

The greater number of parents of the students from the rural arm were involved in alcohol consumption, smokeless tobacco use but fewer smoked compared to their urban counterparts as seen in the Table 6.6. A greater number of the urban parents were known hypertensives and/or diabetics. Three of the rural parents had IHD compared to only one urban parent. (p=0.372)

Figure 2.Distribution of various activities in the study population

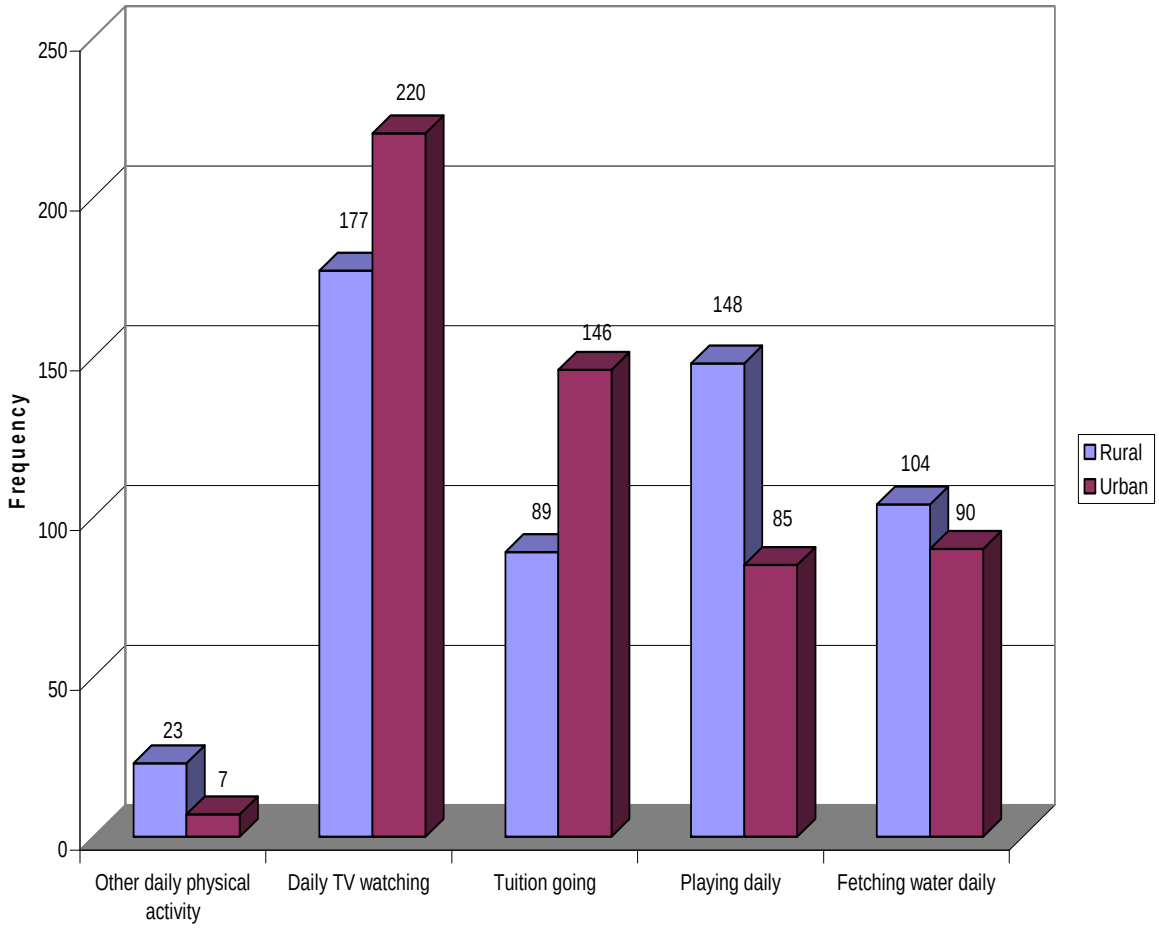


Table 6.7 Distribution of various activities in the study population:

Activity	Rural	Urban
	Frequency	Frequency
Other daily physical activity	23 (9.2 %)	7 (2.8 %)
Daily TV watching	177 (71.0 %)	220 (88.0 %)
Tuition going	89 (35.7 %)	146 (58.4 %)
Playing daily	148 (59.4 %)	85 (34.0 %)
Fetching water daily	104 (41.8 %)	90 (36.0 %)

Table 6.7 shows that more rural students played daily during non school hours and were engaged in daily physical activity other than sports compared to their urban counterparts. TV watching and going to tuitions was more common among urban students. Rural students were also more often involved in fetching water for family needs as a routine (rural 41.6% vs. urban 36.0%,p=1.109)

Table 6.8 Duration (in hours) of watching TV on weekdays in the study population:

Residence	Total	Minimum	Maximum	Mean	Std. Deviation
Rural	177	0.50	5.00	1.23	0.85
Urban	220	0.50	5.00	1.19	0.76

One way ANOVA, p=0.579

Table 6.9 Duration (in hours) of watching TV over weekends in the study population:

Residence	Total	Minimum	Maximum	Mean	Standard Deviation
Rural	181	0.50	7.50	2.88	1.36
Urban	230	0.50	9.50	2.34	1.66

One way ANOVA, p=0.002

Watching TV daily as well as over weekends was more common among urban students, however the mean duration of TV watching among those who watched TV was surprisingly more for the rural group (Table 6.8 and 6.9).

Table 6.10 Duration (in hours) of playing each day, on week days in the study population:

Residence	Total	Minimum	Maximum	Mean	Standard Deviation
Rural	148	0.50	3.00	1.12	0.62
Urban	85	0.50	3.00	1.02	0.52

One way ANOVA, p=0.207

Table 6.11 Duration (in hours) of playing over weekends in the study population:

Residence	Total	Minimum	Maximum	Mean	Standard Deviation
Rural	161	0.50	6.50	2.67	1.21
Urban	207	0.50	9.00	2.56	1.12

One way ANOVA, p= 0.378

The proportion of students playing daily was more among rural students whereas more urban students played over the weekends however the duration among those who played was more for the rural students in either case (Table 6.10 and 6.11).

Table 6.12 Association between overweight and elevated BP in the study population:

	Elevated BP			
Overweight		Yes	No	Total
	Yes	12 (23%)	40 (77%)	52
	No	36 (8%)	412 (92%)	448
Total		48	452	500

Odds ratio = 3.43 (1.65-7.12)

p = 0.002

Table 6.12 shows that being overweight was a risk factor for elevated blood pressure in the entire study group and association was statistically significant.

Table 6.13 Association between the parental history of Diabetes Mellitus and overweight in the study population:

	Overweight			
Parental history of Diabetes Mellitus		Yes	No	Total
	Yes	9 (19.6%)	37 (80.4%)	46
	No	43 (9.7%)	410 (92.3%)	443
Total		52	447	499

Odds ratio = 2.30 (1.04-5.13)

p = 0.042

Table 6.13 shows that in the study population the history of Diabetes Mellitus in any of the parents was a significant risk factor for the students to be overweight.

Table 6.14 Association between the history of playing daily after the school hours and overweight in the study population:

	Overweight			
History of playing daily after school hours		Yes	No	Total
	Yes	17 (7.2%)	216 (92.8%)	233
	No	35 (13.1%)	231 (86.9%)	266
Total		52	447	499

Odds ratio = 0.52 (0.28-0.95)

p= 0.039

As seen in the Table 6.14, playing daily after the school hours protected the students against becoming overweight and this association was statistically significant.

Table 6.15 Association between the history of failure in any class and overweight in the study population:

	Overweight			
History of failure in any class		Yes	No	Total
	Yes	5 (4.6%)	103 (95.4%)	108
	No	47 (12.0%)	344 (88.0%)	391
Total		52	447	499

Odds ratio = 0.36 (0.14-0.92)

p = 0.031

Table 6.15 shows that the proportion of overweight among the student who had failed in any class was significantly less.

Table 6.16 Association between history of watching TV daily and playing after the school hours:

	Playing daily after school hours			
History of watching TV daily		Yes	No	Total
	Yes	171 (43.1%)	226 (56.9%)	397
	No	62 (60.1%)	40 (39.9%)	102
Total		233	266	499

Odds ratio = 0.488 (0.313-0.761)

p = 0.002

The students who watched TV daily were less likely to play daily as depicted in the Table 6.16.

Table6.17 Association of various risk factors to the place of residence:

Risk factor	Rural	Urban	Odds ratio	P value
History of parent using smokeless tobacco	32 (12.8%)	11 (4.4%)	3.2 (1.57-6.37)	0.001*
History of parent using alcohol	100 (40.1%)	67 (26.8%)	1.83 (1.26-2.67)	0.002*
Parental history of hypertension	20 (8.0%)	50 (20.0%)	0.35 (0.2-0.61)	0.000*
Parental history of Diabetes Mellitus	14 (5.6%)	32 (12.8%)	0.40 (0.21-0.78)	0.008
History of failure in class	64 (25.7%)	44 (17.6%)	1.62 (1.05-2.49)	0.03
History of watching TV daily	177 (71.1%)	220 (88.0%)	0.34 (0.21-0.53)	0.000*
History of other physical activity daily	23 (9.2%)	7 (2.8%)	3.53 (1.49-8.40)	0.002*
Playing daily after school hours	148 (59.4%)	85 (34.0%)	2.84 (1.97-4.09)	0.000*
Playing over the weekend (sat and sun)	161 (64.6%)	207 (82.8%)	2.60 (1.71-3.95)	0.000*
Going to tuition	89 (35.7%)	146 (58.4%)	0.39 (0.28-0.56)	0.000*

* p values which are significant after applying Bonferroni correction [66].The corrected p value is 0.005 for the same level of significance as uncorrected p=0.05.

Table 6.17 shows the association between various risk factors and the place of residence of the students in the study group.

A large number of the rural students {68 (27.3%)} were also involved in grazing the cattle daily and the mean duration of grazing cattle was 1.56 hours day. In addition an even greater number {78 (31.3%) of them went for cattle grazing over weekends and holidays for an average of 3.26 hours per weekend day. Among rural students, 41 (16.5%) were also involved in other household activities like caring for the animals, cooking, getting firewood. Among the rural students 29 (11.2%) had to help in the family occupations like garland making, brick work, stone cutting, taking care of the shop and another 16 had to work over the weekend.

Among the urban students 16 (6.5%) had to help in the family occupations like taking care of the shop, beedi making and 25 (10%) had to help the family over the weekends. The students in both the groups were also involved in daily errands like fetching groceries.

6. Discussion

This study was designed to determine the prevalence of risk factors for CAD and to detect the rural-urban differences if any. The study was initially conducted among 8th, 9th, 10th, 11th and 12th grade students but later it was decided to confine the study only to 8th, 9th and 10th grades in the urban area. This explains the presence of a few students of 11th and 12th grades in the rural area and also the slightly older mean age of the rural arm. A higher number of failures among the rural students could also contribute to their higher mean age. The presence of older students in the rural group could have pushed up the measurements like BMI, blood pressure, which are known to increase with age and thereby diluted the true difference. The religious composition of the two groups was quite different. The proportion of students belonging to the Muslim (28.8%) and Christian (8.8%) faiths were significantly higher in the urban area probably due to the location of the school selected, which was a Christian management school close to a Muslim dominated area.

All the students in the rural group were from Tamil medium, compared to the more heterogeneous urban students and this might be a proxy indicator for the students from the lower socioeconomic status (SES) since anecdotally, people from higher SES in rural areas were known to send their children to private schools in urban or suburban areas.

Height was measured to the nearest centimeter and weight to the nearest 0.5 kg and we considered these levels of measurement reasonably accurate since the final indicator used for comparison was body mass index (BMI), a ratio, and quite robust to small changes. The mean BMIs calculated were comparable for the two groups with a marginally higher value for the urban students and it was not statistically significant. The proportion of

overweight as calculated from 90th percentile of ICMR cutoffs was lower for the rural group (22 vs. 30,8.8% vs. 12%) however the difference was not statistically significant (p=0.153). The blood pressure in both the groups was similar, with systolic BP being more in the urban group and diastolic BP more among the rural students. The proportion of students with elevated blood pressure (9.2% for rural and 10% for urban) was very much same for both groups. These findings are in contrast to those reported in many other studies where the urban students were found to have higher BMI and higher blood pressure values at each age[7] . The mean waist circumference was greater for the urban group (63.35 vs. 61.25, p =0.003). This is in line with available literature. Thus objectively measurable risk factors like overweight, elevated blood pressure were almost equally distributed in both rural and urban areas with a marginally higher waist circumference among the urban students.

None of the 500 students interviewed reported current smoking, using smokeless forms of tobacco or consuming alcohol. All the students also denied having tried any of the above. However a few agreed that some of their classmates were actually smoking, using smokeless tobacco or consuming alcohol, but the students who were identified denied the same. These findings are in contrast to most of the other studies reported from the country ,even south India [32-34] and might be due to the fact that the data was collected by personal interviews as against the anonymous questionnaire used in other studies. This could also be due to the fact that the interviewer was not able to develop rapport with the students within very short duration of the interview and that the interview was conducted in the school. The overall falling trends in the tobacco use pattern in the society and the setting from where most of the studies are reported should also be taken in consideration. Given the sensitive

nature of the questions probably anonymous survey or focus groups discussion could have picked up the information more closure to the truth.

Paternal smoking was present in 28.4 % of the subjects in the rural area as compared to 31.6% in the urban population. All the parents smoked in the home thereby exposing the entire family to the smoke and its ill effects. Passive smoking has been considered a risk factor for CAD as proved in many studies. The smokeless tobacco use (12.8% vs. 4.4%) alcohol consumption (40% vs. 26.8%) among the parents of the rural students was considerably higher than their urban counterparts and the differences were significant. This is similar to findings reported from other studies that looked at the patterns of tobacco consumption in India [67, 68]. There were very few students with family history of smoking alcohol or smokeless forms of tobacco and where the family history was not in the father. Even though the parental use of alcohol and other substance abuse has not been considered to be a risk factor for CAD, the available literature suggests [56-60] that substance abuse among parents was associated with similar behaviour among their offspring in adolescence and adulthood.

Parental history of hypertension (20% vs. 8%) and diabetes mellitus (12.8% vs. 5.6%) was significantly higher for the parents of urban students, which is in keeping with the higher prevalence of Diabetes mellitus and hypertension in the urban population [69]. Though ischemic heart disease was more frequent among the parents of the rural students, the numbers are too small to draw any inferences. Premature coronary artery disease has how ever been considered a strong risk factor for the offspring [22] .Thus the study group represents a subset of adolescents who by themselves have low CAD risk factors in terms of BMI, overweight, blood pressure levels, and tobacco and alcohol consumption habits.

On the other hand they have quite a high frequency of familial risk factors and conditions in family which make them susceptible to developing CAD later in life. The long term outcome of this group will depend on the interventions among the school age children.

All the schools included in the study provided for two playtime periods of 45 minute each per week and almost all the students played during those periods. The common games played were khokho, kabbadi, volleyball, cricket, chasing, and few athletics. Similar games were played by both the rural and urban group with a few students playing hockey in the urban school. The commonly played games outside the school were cricket, volleyball, chasing, and ispy. The proportion of students playing daily during non school (59.4% vs.34%) hours was significantly higher for the rural students where as the proportion of students going for tuitions daily (58.4% vs.35.7%) and watching TV daily (88% vs.71%) was higher for the urban students. The higher proportion of urban students watching TV and going for tuitions probably explains lesser number of urban students playing daily apart from school hours. Similarly the duration of playing daily as well as over the weekends was higher for the urban group though not significantly. Even though higher proportion of urban students watched TV daily and over weekends the duration among those who watched TV was more for the rural group. The findings suggest that probably the 'weekend phenomenon' has crept into the rural population. Only a very small proportion of the students in either group were involved in routine physical activities, the same being even lower in the urban students. A very high proportion of students from both the groups routinely fetched water for their family, the number being slightly higher among the rural students. A large number of the rural students {68 (27.3%)} were also involved in grazing the cattle daily and the mean duration of grazing cattle was 1.56 hours day. In addition an even greater number {78 (31.3%) of them went for cattle grazing over weekends

and holidays for an average of 3.26 hours per weekend day .41 (16.5%) rural students were also involved in other household activities like caring for the animals, cooking, getting firewood. 29 (11.2%) students had to help in the family occupations like garland making, brick work, stone cutting, taking care of the shop and another 16 had to work over the weekend. Among the urban students 16 (6.5%) had to help in the family occupations like taking care of the shop, beedi making and 25 (10%) had to help the family over the weekends. The students in both the groups were also involved in daily errands like fetching groceries. Thus the involvement of the rural students in the physical activities was considerably higher than the urban students, which was inherent to their life style. No attempt was made to classify various activities based on calorie consumption as done by many other studies due to inherent difficulties in collecting such data from participants in such a young age group. Even though the urban students were less often involved in physical activities, played less, had more competitive life, had more familial risk factors, the prevalence of objectively measurable risk factors were very much similar to their rural counterparts as already discussed. This again points to the multifactorial aetiology and gaps in our knowledge about natural history of non-communicable diseases.

Though the study was mainly designed to look at the differences in the prevalence of various CAD risk factors based on the residence of the students, there were few significant finding when the pooled data was considered and these are discussed in the following section. Overweight as defined by BMI > 90^{th} percentile of ICMR cutoffs was a significant risk factor for elevated blood pressure (pre-hypertension and hypertension) with risk being about three and a half times in the overweight students. This association has also been reported in several other studies [7,70] .Overweight in turn was associated with parental history of diabetes mellitus

and history of playing daily apart from the non school hours. As expected the parental history of diabetes mellitus was a risk for being overweight, risk being about 2.3 times. Similar finding have been reported from several studies including the Bogalusa Heart study [22] Playing daily protected against being overweight, by halving the risk compared to those who did not play regularly. These findings are in line with those from the available literature [52,53]. The students who watched TV daily were less likely to play daily compared to those who never watched TV or did so only occasionally, which is again a well known fact. Another interesting finding was that those who had failed in any class were less likely to be overweight compared to those who got through without failures. This finding could not be explained by the study data. The rural residence was a significant risk factor for failing in a class risk being 1.62 times over the urban residence, which is on expected lines and the study did not attempt to look into the reasons for the same.

As discussed above the risk factors for CAD are present in the rural and urban students with different distribution pattern. This in addition to the genetic and ethnic susceptibility to early development of CAD in Indian population places the community in a very delicate position .The increased number of CAD cases reported from various tertiary centers among young adults and increasing prevalence of CAD among young adults in community based studies re-affirm the same. Though the overall prevalence of risk factors for CAD in the study group is high that of objectively measurable risk factors is not so. This however should be viewed with the fact that biochemical markers were not considered in the study.

The information obtained from the study also provides an excellent rationale for trying out various prevention strategies. One such option is school based health education approach, based on the common risk factors for non-communicable diseases and life style modification.

We have developed a health education module for high school students, which will be field tested in department's school health education programme.

7. Limitations of the study

1) The sample selected was not representative of the all high school students in this area and particularly more so in the urban area. Further, the study excluded rural students who studied in urban schools.
2) Although the questionnaire was pilot tested and refined, this was not a validated one and hence validity of the data collected as well as comparability with other studies could be questioned.
3) As the interview was conducted by the investigator in person, the answers to a few sensitive questions like smoking, alcohol use and smokeless tobacco may not have been accurate due lack of rapport and confidentiality issues. This could have been overcome by focus group discussions for such issues.
4) The interviewer was not able to administer all the questions related to the stress due to language problem.
5) The reliability of the parental history of risk factors for the urban students could not be confirmed.
6) The study did not include any of the biochemical markers.

8. Conclusions

This study was designed to determine the prevalence of risk factors for CAD and also to look out for the rural-urban differences if any. A total of 250 students from rural areas of Kaniyambadi block and 250 from the Vellore town were included in the study. The students in both the rural and urban area have high prevalence of various CAD risk factors. How ever in absence of any reliable score taking into consideration all this risk factors, the exact risk in each group can not be quantified. Thus the study group represents a subset of adolescents who by themselves have low CAD risk factors in terms of BMI, overweight ,blood pressure levels, tobacco and alcohol consumption habits , on the other hand they have quite high familial risk factors and conditions in family which make them susceptible to developing CAD later in life. The urban students were also found to less physically active and led a more competitive life, thereby increasing their CAD risk. The increasing competition among students very early in life is probably depriving many of the children of a healthy childhood as indicated by high proportion of students attending tuitions. TV watching being resorted to as the main relaxation and in certain cases addictive TV watching is of concern. The fact that about 10% of the students in the study has to help out their family occupation also needs to be looked at.

Many of the CAD risk factors are modifiable .The students, teacher and parents need to be made aware of this. The traditional concept of school health dealing mainly with communicable diseases need to be reoriented to meet the newer health challenges. Teaching about healthy life style should be included in the syllabus. The teachers need to be trained to incorporate healthy life style and stress management in their teaching sessions. The high school period probably is the best time to start any intervention to prevent non-

communicable diseases as the high school students have some idea about the risk factors and start getting exposed to considerable amount of stress both in the school as well as in the home. A health education module (Appendix 3) for the high school students has been proposed here and needs to be field tested in department's school health education programme.

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Appendix 1

Questionnaire

Study number:

1) Name:

2) Sex:

3) Age:

4) Grade:

5) Religion / Caste:

6) Height (cm):

7) Weight (kg):

8) Body- Mass Index:

9) Waist circumference (cm):

10) Blood pressure (mm of Hg): 1)
2)

11) Smoking:

1. Have you ever smoked Yes / No .if yes
2. Do you smoke currently? Yes / No
3. Age at starting
4. Type beedi /cigarette /others
5. Average consumption
   a) frequency
6. Does anyone in your family smoke Yes / No
   If yes who ___
7. During the past 12 months have you ever reduced or stopped smoking, as a conscious decision, even for a short period? Yes / No

12) Smokeless tobacco use:

1. Have you ever used a smokeless tobacco product? Yes / No if yes
2. Do you use any smokeless tobacco product currently? Yes / No
3. Age at starting
4. Type
5. Average consumption
    a. frequency
    b. amount
6. Does anyone in your family use any smokeless tobacco product? Yes / No
    If yes who _____
7. During the past 12 months have you ever reduced or stopped using smokeless tobacco product, as a conscious decision, even for a short period? Yes / No

13) Alcohol:

1. Have you ever consumed alcohol? Yes / No if yes
2. Do you consume alcohol in any form currently? Yes / No
3. Age at starting
4. Type
5. Average consumption
    a. frequency
    b. amount
6. Does anyone in your family consume alcohol? Yes / No
    If yes who _____
7. During the past 12 months have you ever reduced or stopped using alcohol, as a conscious decision, even for a short period? Yes / No

14) Family history:

Hypertension	father / mother / both / none / DK
Ischaemic heart disease	father / mother / both / none / DK
Stroke	father / mother / both / none / DK
Diabetes mellitus	father / mother / both / none / DK
Dyslipidemias	father / mother / both / none / DK

15) History of stressful event

Did you ever fail in any grade?	Yes / No
Do you feel academic competition is too much?	Yes / No
Did you ever have suicidal ideations?	Yes / No
Did you ever not sleep for any known cause?	Yes / No

16) Physical activity:

1) **School related activities:**

a) Distance from house:

b) Mode of transport used

Mode: Time-taken (min):

c) Sessions academic number duration

d) Physical training sessions number duration

e) Sports activity

1 duration/day
2 duration/day
3 duration/day

f) Recess time activity

1 duration/day
2 duration/day
3 duration/day

g) Staircase climbing at school

number of stairs number of times

2**) Leisure time activities:** sat/sun

a) Watching TV duration / day

b) Sports duration /day

1)
2)

c) Other physical activities duration /day

1)
2)

d) Studying at house duration /day

e) Tuitions Distance traveled
Mode of travel
Time taken
Duration of studying

3) **Home related activity:** duration/day sat/sun

Sleep
Shopping for groceries
Fetching water
Cooking
Caring for children
Caring for animals
Watering plants
Gardening
Others

4) **Family occupation related activity:** duration/day sat/sun

Family occupation:
Milking animals
Carrying fodder for animals
Chopping wood
Grazing animals
Others

17) Do you feel that the amount of food you get is sufficient?

Always sufficient
Sometimes no
Most of the times no
Always hungry

Appendix 2

Protocols for measurements

Height measurement protocol:

1. The participants were asked to remove shoes, socks, slippers and any head gear (hat, cap, etc).

2. The participant was asked to stand next to the height scale with their feet together and heels against the wall, knees straight.

3. The participant was asked to look straight ahead and NOT look up with eyes and ear at the same level.

4. A flat cardboard was placed of top of head and the height recorded in centimeters to the exact point (nearest 0.1cm).

Weight measurement protocol:

1. The scale was put on a firm, flat surface.

2. The participants were asked to remove footwear and socks.

3. The participants were asked to stand still, facing forward and arms on the side and wait until told to step off.

4. The weight was recorded in kilograms.

Waist circumference measurement protocol:

1. In the mid-axillary plane, the inferior margin of the last rib and the crest of the ileum were located. The midpoint was marked. The measuring tape was applied over the marked midpoint. Care was taken to ensure that the tape was horizontal across the back.

2. The participant was to stand with their feet together, their arms placed at the side with the palms of the hands facing inwards and to breathe normally and the measurement is taken at the end of a normal expiration with the arms relaxed at the sides.

3. Measurement was taken only once and recorded to the nearest 0.1 cm.

Ideally the measurement should have been taken without clothing but due to practical problems this was not possible and the measurements were taken over light clothing.

Blood pressure measurement protocol:

1 The participant was asked to sit quietly and rest for 5 minutes.

2. The right arm of the participant was placed on the Table with the palm facing upward and was made free of any clothing.

3. The cuff snugly was wrapped onto the right arm and securely fastened it with the Velcro tape. The lower edge of the cuff was placed 1.5 to 2.5 cm above the inner side of the elbow joint.

4. Care was taken to keep the level of the cuff at the same level as the heart during measurement.

5. The right radial artery was palpated and cuff inflated until pulsation disappeared and continued to inflate 30 mm Hg beyond this point.

6. The diaphragm of the stethoscope was applied to the right antecubital fossa and auscultated for pulse sounds while deflating the cuff slowly.

7. The systolic blood pressure (SBP) was recorded when a pulse was first audible.

8. The diastolic blood pressure (DBP) was recorded when the pulse sound disappeared.

Two blood pressure reading were recorded one at beginning of interview after enquiring about age, grade, religion, height and weight recording. Second reading was recorded at the end of the interview.

Appendix 3
Health education module

Target group: High school student from rural and urban schools.

Objectives:

At the end of the session the students should be

1) Able to describe basic structure and working of the heart.
2) Aware that the coronary artery disease is an emerging problem in the youth.
3) Able to enlist the risk factors for the coronary heart disease and classify as modifiable and non modifiable.
4) Able to enlist the various means of preventing non-communicable diseases.
5) Able to identify the role of student community as instruments of changing health risk profile of other family members.

Pretest assessment: using the questionnaire provided.

Session plan:

Serial No.	Topic	Duration	Strategy
1	Introduction to basic anatomy and physiology of heart	5 min	Discussion Flip charts
2	Describing the magnitude of the problem at global, national, regional level.	5 min	Lecture Discussion

Serial No.	Topic	Duration	Strategy
3	Listing down the risk factors for non communicable diseases and classifying them as modifiable and non-modifiable.	10 min	Brainstorming Discussion
4	Teaching about healthy life style : Nutrition and diet Importance of physical activity Avoiding smoking and smokeless tobacco use. Problems with excessive TV watching Stress management.	20 min	Discussion Lecture Flip charts
5	Role of students in preventing non communicable diseases and concept of social action.	5 min	Discussion Lecture

Post test evaluation: using the questionnaire provided.

Pretest questionnaire

1) How does heart get its blood supply?
    a) Does not need blood supply
    b) Directly from the chambers
    c) Has special blood vessels.
2) Heart attack among Indians occur
    a) More frequently, less severe
    a) More frequently, more severe
    a) Less frequently, less severe
    a) Less frequently, less severe
3) List any four risk factors for developing heart attack.
4) History of parent with high blood pressure increases the chance of offspring having high blood pressure. True / False.
5) Regular medical checkup is necessary to detect high blood pressure. True / False.
6) List out any four food items which increase chances of getting heart attack.
7) Regular physical activity is necessary for a healthy heart. True / False.
8) Passive smoking increases the chances of getting heart attack. True / False.
9) Yoga and other relaxation technique have a role in stress management. True / False.
10) Students can play important role in controlling risk factors for heart attack among other family members. True / False.